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Nanotechnology-based processes for treating various natural or synthetic substrates in order to induce antimicrobial, antibiofilm, antifungal, antialgic or even antiviral activity

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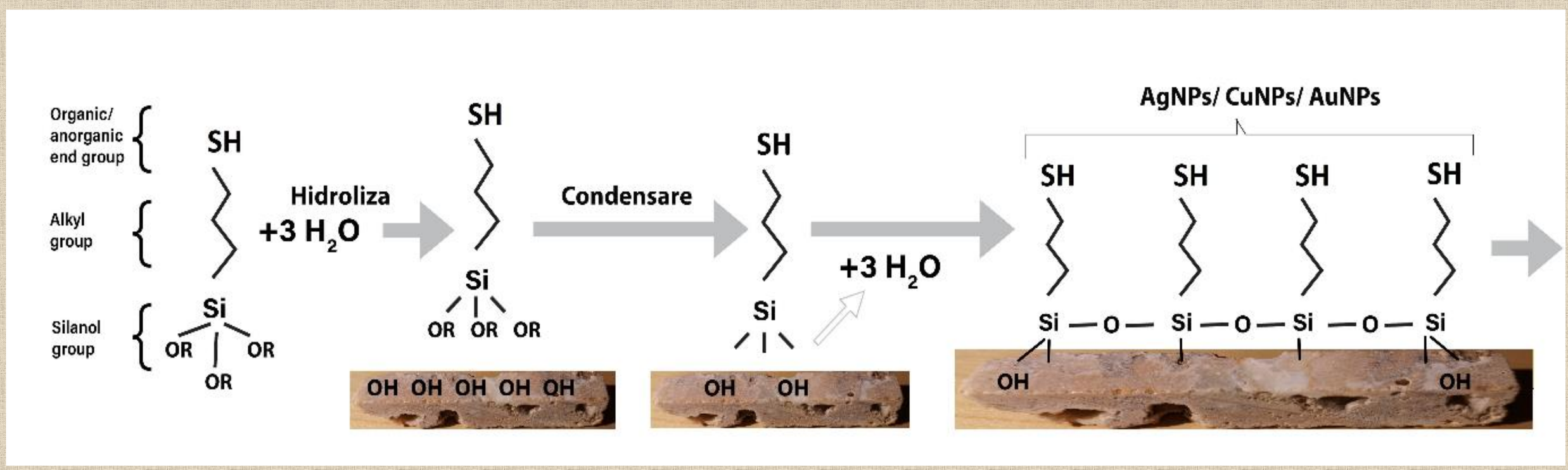
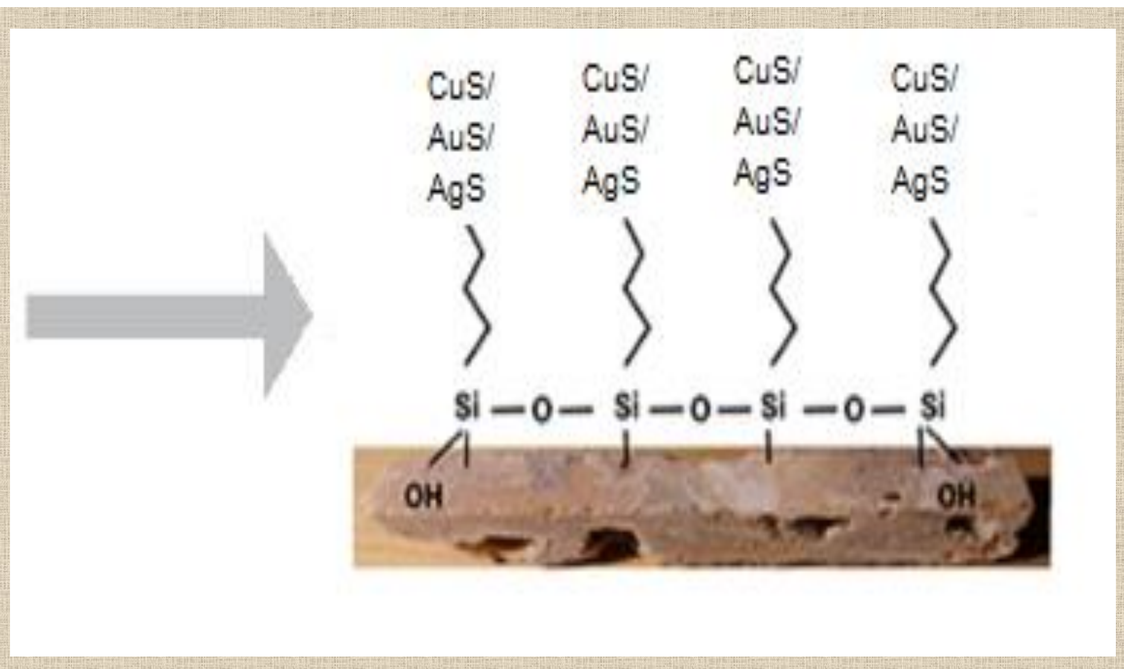
Abstract:

The invention consists in developing new systems for the treatment of various substrates such as: natural stone, brick, concrete, glass, etc. and the related treatment method. The proposed system consists in the use of organo-siloxane functionalization agents based on $(RO)_3Si\text{-}C_aH_bSH$. The proposed solutions will have a variable content of functionalizing agents and solvent, especially alcohols that will increase the penetration depth. These functionalizing agents have multiple roles, by condensation they form network-type structures that repair existing cracks and at the same time confer the selective permeability of the substrate while the presence of functional groups will induce new properties, including self-cleaning, antimicrobial, antifungal, antibiofilm especially if decorated with proper nanoparticles such as Ag, Cu or Au being effective in the case of civil or special constructions (dams, swimming pools, treatment plants), monuments, etc. Surface treatment will be done by any available technique, such as: sprays, brushing, roller application, etc. The application can be done in one layer or in multiple layers, in which case it is recommended to apply successive layers, oriented perpendicular to each other to ensure a uniform application.

Experimental:





Conclusions:

The surface is silanized using adequate silanisation agents bearing thiolic groups. Due to the presence of these groups, AgNPs, CuNPs or AuNPs will be decorated onto these surfaces via covalent bonds and thus self-cleaning, antimicrobial, antifungal or antibiofilm activity will be induced. These treatment opportunities can be applied on the clean surfaces for preventing biofilm formation or, it can be used as an efficient solution in treating the already inoculated surfaces and to destabilize these biofilms. As a consequence of the covalent immobilization of the nanoparticles, these will be retained for a longer period of time and thus long lasting activity is expected. From environmental point of view, it is expected that no / low dose of nanoparticles and ions will be release which means that low negative environmental impact is expected.

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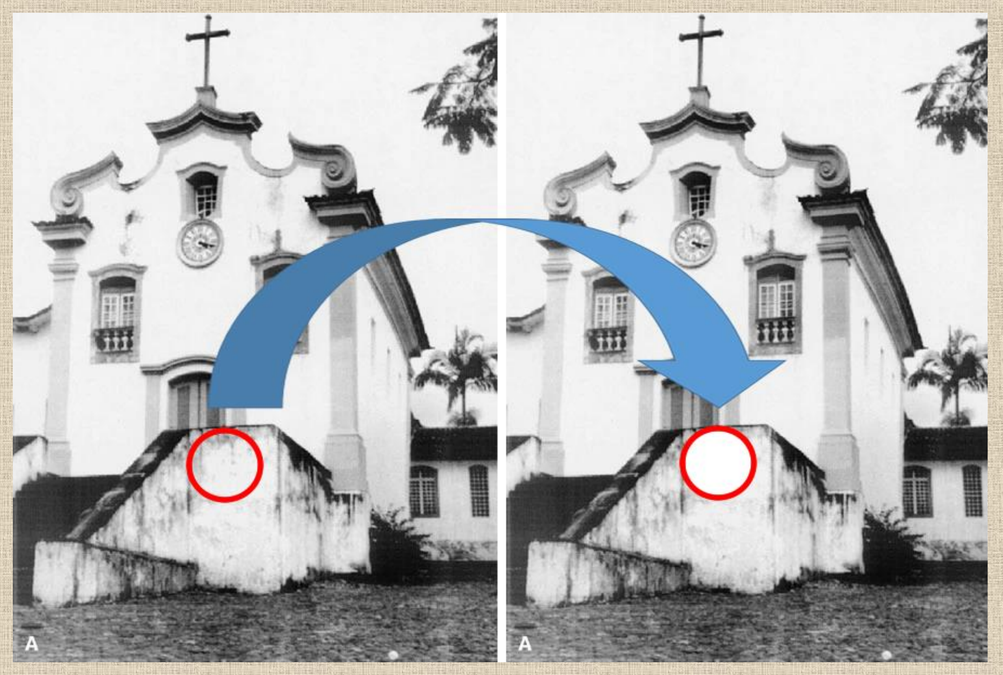

Adapted according to: C.A. Crispim & C.C. Gaylarde, Cyanobacteria and Biodeterioration of Cultural Heritage: A Review; *Microbial Ecology* volume 49, pages 1–9 (2005)